

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
23 December 2004 (23.12.2004)

PCT

(10) International Publication Number
WO 2004/111388 A1

(51) International Patent Classification⁷: **E21B 47/10,**
G01V 1/50

LT, MA, ML, MR, NE, NL, OM, SD, SN, TD, TG, TN, TR,
TT, US, VN): SCHLUMBERGER TECHNOLOGY B.V.
[—/NL]; Parkstraat 83-89, NL-2514 JG The Hague (NL).

(21) International Application Number:
PCT/EP2004/005079

(71) Applicant (for all designated States except GB, JP, NL):
SCHLUMBERGER HOLDINGS LIMITED; PO Box
71, Craigmuir Chambers, Road Town, Tortola (VG).

(22) International Filing Date: 12 May 2004 (12.05.2004)

(25) Filing Language: English

(71) Applicant (for all designated States except CA):
SCHLUMBERGER CANADA LIMITED [CA/CA];
525 3rd Avenue S.W., Calgary, Alberta T2P 0G4 (CA).

(26) Publication Language: English

(30) Priority Data:
03291350.1 6 June 2003 (06.06.2003) EP

(71) Applicant (for all designated States except CN):
SCHLUMBERGER OVERSEAS S.A. [PA/PA]; 8
Calle Aquilino de la Guardia, Panama City (PA).

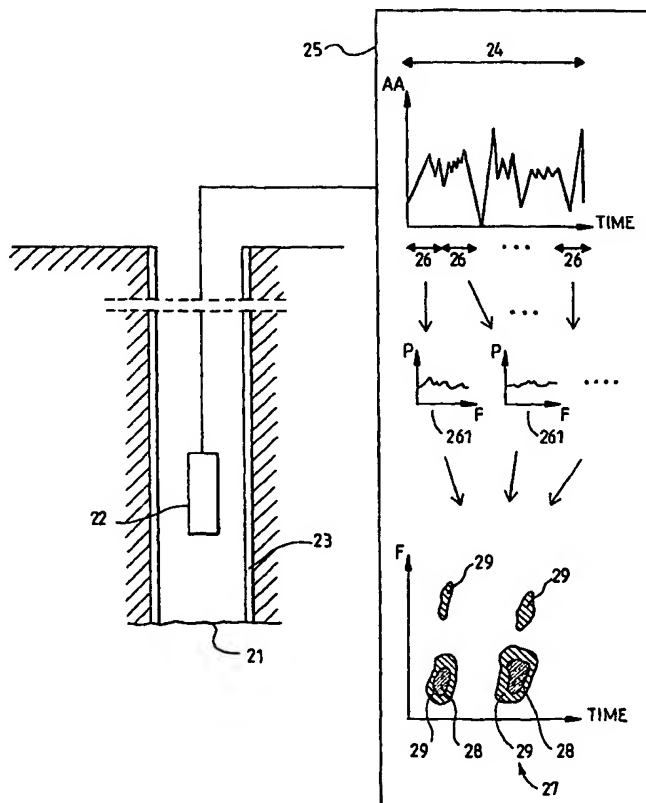
(71) Applicant (for all designated States except FR): **SER-
VICES PETROLIERS SCHLUMBERGER** [—/FR];
42, rue Saint Dominique, F-75007 Paris (FR).

(71) Applicant (for all designated States except OM, SD, SY,
TR): **SCHLUMBERGER OILFIELD ASSISTANCE
LIMITED**; Craigmuir Chambers, Road Town, Tortola
(VG).

(71) Applicant (for all designated States except BF, BJ, BR, CA,
CF, CG, CI, CM, CZ, FR, GA, GB, GN, GQ, GW, IN, JP,

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR ACOUSTIC DETECTION OF A FLUID LEAK BEHIND A CASING OF A BOREHOLE



(57) Abstract: An acoustic detection of a discrete acoustic signal allows to detect a leak behind a casing (23) of a borehole. An acoustic amplitude (AA) is sampled during a recording time period (24 ; 64) at a determined position along the tube. Time intervals (26 ; 66) are defined inside of the recording time period (24), and for each time interval (26) the measured acoustic amplitudes are processed to obtain respectively a corresponding power-frequency spectrum (261). A plurality of the power-frequency spectra are analyzed to identify the discrete acoustic signal by detecting time and frequency dependant changes of power. Preferably the processing involves a Fourier transform analysis. A power-frequency time plot is used to conveniently identify the discrete acoustic event.



- (71) Applicant (for all designated States except BR): **SCHLUMBERGER SURENCO S.A.** [PA/PA]; 8 Calle Aquilino de la Guardia, Panama City (PA).
- (71) Applicant (for all designated States except TT): **SCHLUMBERGER SERVICES LIMITED**; P.O. Box 438, Tortola (VG).
- (71) Applicant (for all designated States except EG): **SCHLUMBERGER SEACO INC.** [PA/PA]; 8 Calle Aquilino de la Guardia, Panama City (PA).
- (71) Applicant (for BF, BJ, CF, CG, CI, CM, CZ, GA, GN, GQ, GW, IN, LT, MA, ML, MR, NE, SN, TD, TG, TN, VN only): **PETROLEUM RESEARCH AND DEVELOPMENT N.V.** [NL/NL]; De Ruyterkade 62, Willemstad, Curaçao (AN).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **JAMES, Simon** [GB/FR]; c/o Etudes et Productions Schlumberger, 1, Rue Henri Becquerel, B.P. 202, F-92142 Clamart Cedex (FR). **FITZGERALD, Peter** [GB/FR]; c/o Etudes et Productions Schlumberger, 1, Rue Henri Becquerel, B.P. 202, F-92142 Clamart Cedex (FR).
- (74) Agent: **MENES, Catherine**; Etudes et Productions Schlumberger, 1, Rue Becquerel, BP 202, F-92142 Clamart Cedex (FR).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.